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APPENDIX 31
AUXILIARY BUS INTERFACE
FINAL SOFTWARE REPORT
DATA ITEM NO. A005

# INTEGRATED ELECTRONIC WARFARE SYSTEM
# ADVANCED DEVELOPMENT MODEL (ADM)

78009887-31

PREPARED FOR

NAVAL AIR DEVELOPMENT CENTER
WARMINSTER, PENNSYLVANIA

CONTRACT 62269-75-C-0070

**RAYTHEON**

ELECTROMAGNETIC
SYSTEMS DIVISION

1 OCTOBER 1977

APPENDIX 31

AUXILIARY BUS INTERFACE

FINAL SOFTWARE REPORT

DATA ITEM A005

INTEGRATED ELECTRONIC WARFARE SYSTEM (IEWS)
ADVANCED DEVELOPMENT MODEL (ADM)

Contract No. N62269-75-C-0070

Prepared for:

Naval Air Development Center
Warminister, Pennsylvania

Prepared by:

RAYTHEON COMPANY
Electromagnetic Systems Division
6380 Hollister Avenue
Goleta, California 93017

1 OCTOBER 1977

TYPE OF SPEC

## INTERFACE CONTROL DOCUMENT

TITLE OF SPEC

## AUXILIARY BUS ICD

| FUNCTION | APPROVED | DATE | FUNCTION | APPROVED | DATE |
|----------|----------|------|----------|----------|------|
| WRITER | J. Kolanek | 25 July 1975 | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

### REVISIONS

| CHK | DESCRIPTION | REV | CHK | DESCRIPTION | REV |
|-----|-------------|-----|-----|-------------|-----|
| CPF/ | Complete Revision 12/15/75 | 1 | | | |
| CRD | See Below 8/5/76 | 2 | | | |

Title:
  Was: SORTER AUXILIARY OUTPUT ICD
  IS: AUXILIARY BUS ICD

Para. 3.1.3
  Was: ... Equipment shall respond by raising...
  Is: Equipment shall respond by lowering...

Figure 3: 2 places
  Was: USFG
  Is: UPDW
  Was: Technique Number
  Is: ET Channel Number
  Was: 0 = Unassoc. PDW
  Is: 1 = Unassoc. PDW

Was: Tech. Gen. Only
  Is: To Tech. Gen. & Emitter Tracker
Was: 1 = Tech. Gen. Destin.
Is: $AGTG \cdot \overline{UPDW}$ = Tech. Gen. or Emitter Tracker Destin.
Was: 1 = Sys. Contr. Destin
Is: SC V UPDW = Sys. Contr. Destin.

Figure 5.
  Add: pin numbers

| REVISION | | | | | | | | | | | | | | | | | | |
|----------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|
| SHEET NO. | | | | | | | | | | | | | | | | | | |
| REV STATUS OF SHEETS | REVISION | | | | | | | | | | | | | | | | | |
| | SHEET NO. | | | | | | | | | | | | | | | | | |

10-1348 (11/68) VELLUM PRINTED IN U.S.A.

1.0      SCOPE

This document shall specify the auxiliary output from Sorter. The functional as well as detailed physical requirements shall be included in this specification.

2.0      APPLICABLE DOCUMENTS

(TBD).

3.0      REQUIREMENTS

3.1      INTERFACE DEFINITION

3.1.1      General

An interface shall be defined at the Sorter which provides Jammer Pulse Words (JPW), Unassociated Pulse Descriptor Words (UPDW) and/or Selected Pulse Descriptor Words (SPDW). A number of users shall simultaneously have access to this interface and shall at least include: Emitter Tracker, Technique Generator, System Controller and the Special Test Equipment.

The interconnections among the various units shall be organized functionally as shown in Figure 1: Units shall be interconnected using a synchronous bus structure which allows either the Sorter or the Special Test Equipment to output data on the bus. All other units shall be destination devices. In addition, the Special Test Equipment shall monitor the data traffic generated by the Sorter.

3.1.2      Bus Structure

The interface shall consist of three sets of lines.

a. 16 DATA lines

b. 4 IDENT lines

c. 3 control lines LOAD, $\overline{\text{ACTIVE}}$, ENABLE

The DATA lines shall be used to transfer the output message contents. The IDENT lines shall be used to identify the content of the DATA. The control
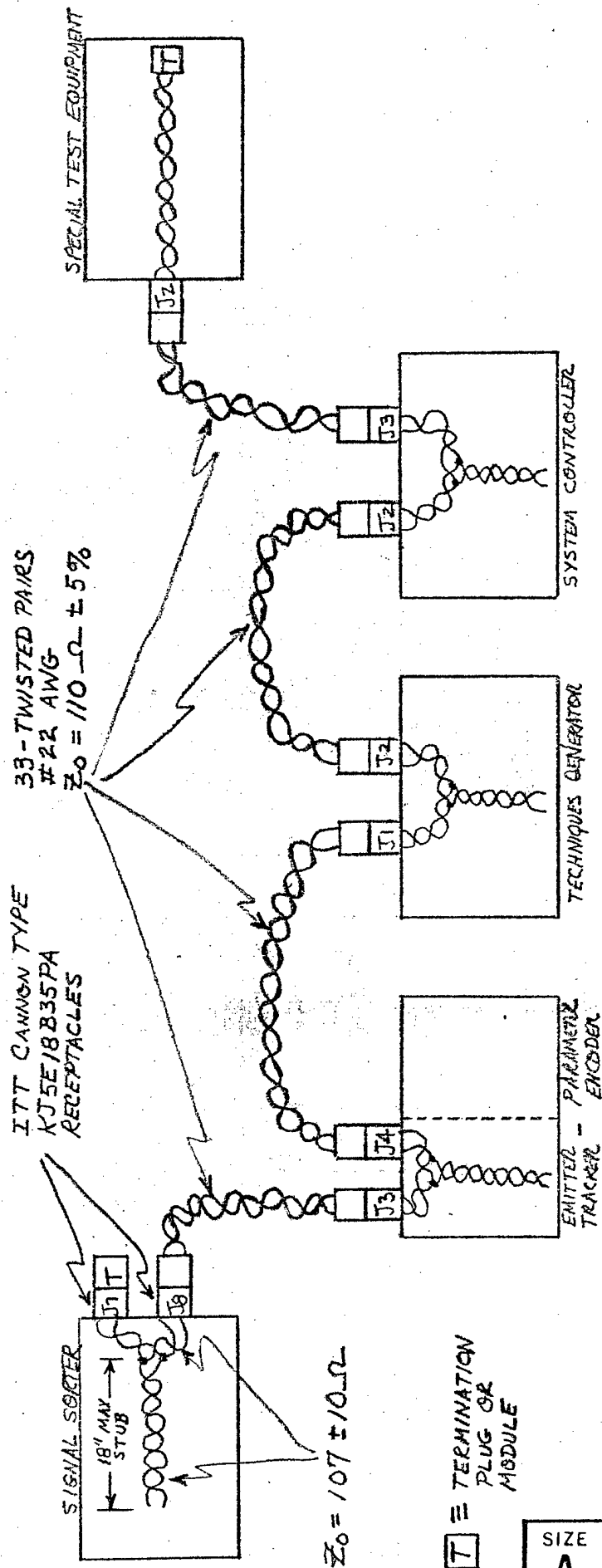
SPECIAL TEST EQUIPMENT

JZ

33 - TWISTED PAIRS
#22 AWG
$Z_o = 110 \, \Omega \pm 5\%$

ITT CANNON TYPE
KJ5E18 B35PA
RECEPTACLES

SYSTEM CONTROLLER

J3

J2

TECHNIQUES GENERATOR

J2

J1

EMITTER - PARAMETRIC
TRACKER - ENCODER

J4

J3

SIGNAL SORTER

J1

J6

←18" MAX→
STUB

$Z_o = 107 \pm 10 \, \Omega$

T = TERMINATION
PLUG OR
MODULE

FIGURE 1. AUXILIARY BUS – SIGNAL SORTER INTERFACE

| SIZE | CODE IDENT NO | DRAWING NO. |
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lines shall be used to control the data transfer.

### 3.1.3  Bus Control

Bus control shall reside in both the Sorter and the Special Test Equipment, however, only one device shall exercise bus control at a given time. Primary control shall reside with the Sorter which shall authorize control of the bus to the Special Test Equipment.

The Sorter shall grant bus control to the Special Test Equipment by raising the ENABLE line whenever the Sorter has no output pending. The Special Test Equipment shall, respond by raising the ACTIVE line and shall assume control of the bus. The Sorter shall regain bus control by lowering the ENABLE line and the Special Test Equipment shall respond by lowering the ACTIVE line and relinquish bus control. The ACTIVE line shall not be lowered, however, until any message in process has been transmitted.

### 3.1.4  Selected Pulse Descriptor Words (SPDW)

SPDW's shall be defined as Pulse Descriptor Words (PDW) which have been associated with selected active track files within the Sorter for which the System Controller has requested PDW's. These messages shall consist of PDW's with a header identifying the track file it has been associated with.

### 3.1.5  Jammer Pulse Words (JPW)

JPW's shall be defined as messages consisting of certain PDW and track file data which shall be outputted each time PDW associations are made with selected track files specified by the System Controller. This data shall consist of the track frequency, track azimuth, last time of arrival and the track file identification.

3.1.6    Unassociated Pulse Descriptor Word (UPDW)

UPDWs shall be defined as PDWs which have not been associated with active track files within the Sorter. These messages shall consist of PDWs with a header whose track file number is invalid.

3.2    CHARACTERISTICS

3.2.1    Performance Requirements

3.2.1.1    Interface Bus Timing.   The bus timing shall be as shown in Figure 2.

3.2.1.2    Interface Bus Capacity.   The bus shall have a maximum transfer capacity of four million words per second.

3.2.1.3    STE Connection.   The interface shall provide proper system operation with and without the STE connected to the interface. In order that the Sorter interface operate properly without the STE response on the control line, the Sorter Enable pulse shall be a $\geq 375$ nanosecond pulse. The STE must respond by lowering the $\overline{ACTIVE}$ line in $\leq 550$ nanoseconds.

3.2.2    Physical Requirements
TBD.

3.3    DATA FORMATS

SPDWs, UPDWs and JPDWs shall be combined into a single output message block shown in Figure 3. The identification code shall be generated by the device, Sorter or Special Test Equipment, which is transmitting the data.

3.4    DESIGN REQUIREMENTS

3.4.1    Line Drivers/Line Receivers

All line drivers and line receivers shall incorporate SN75110 and SN75107A type devices respectively. The Auxiliary Bus shall be terminated on both ends with the termination network specified in Figure 4. The optional biasing network shall be used to bias interface lines in the absence of drivers.
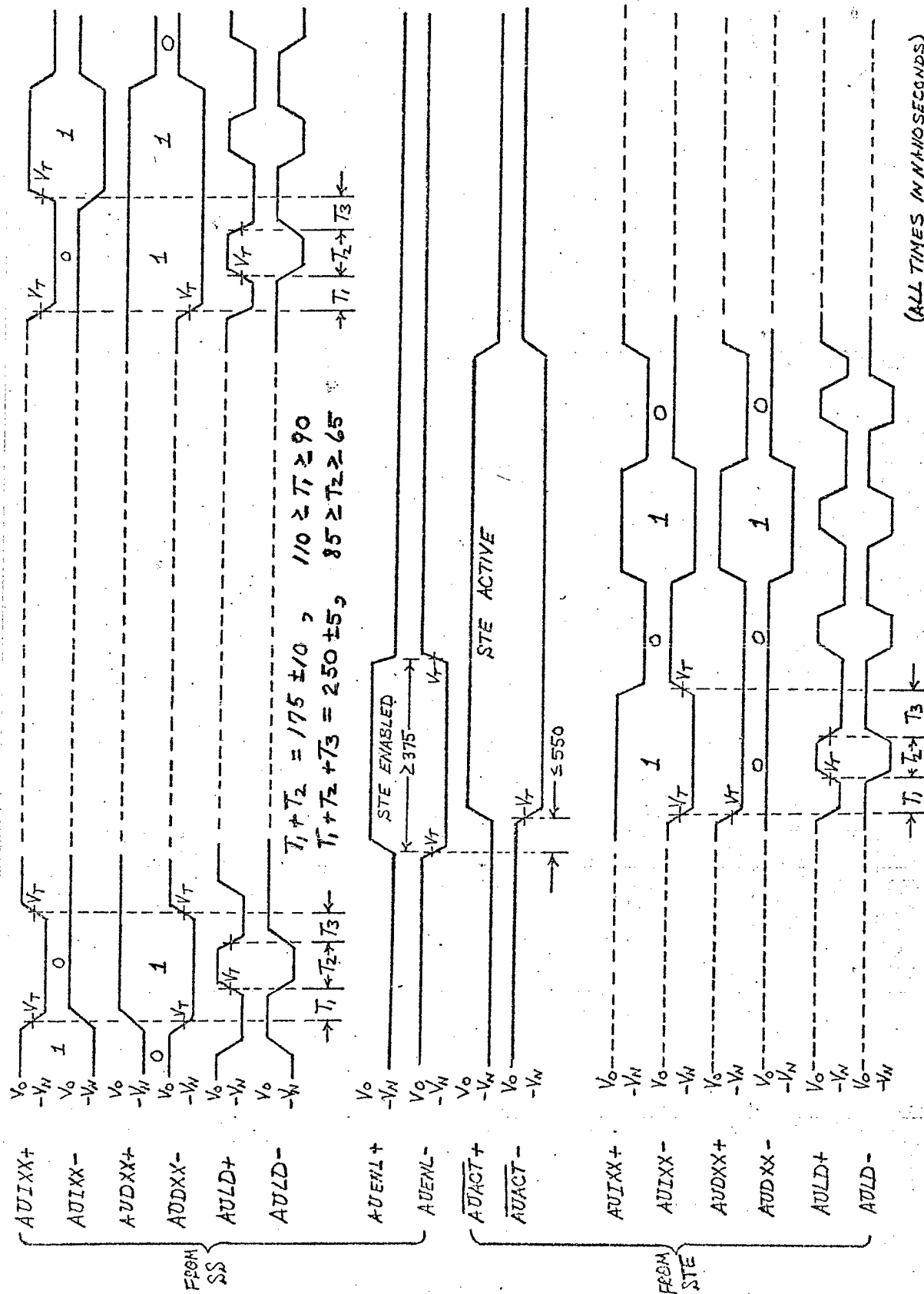
CPD 12/15/75

(ALL TIMES IN NANOSECONDS)

$T_1 + T_2 = 175 \pm 10$, $110 \geq T_1 \geq 90$
$T_1 + T_2 + T_3 = 250 \pm 5$, $85 \geq T_2 \geq 65$

STE ENABLED
$\geq 375$

STE ACTIVE
$\leq 550$

AUIXX+
AUIXX−
AUDXX+
AUDXX−
AULD+
AULD−

AUENL+
AUENL−

$\overline{AUACT+}$
$\overline{AUACT−}$

AUIXX+
AUIXX−
AUDXX+
AUDXX−
AULD+
AULD−

FROM SS

FROM STE

$V_O$ −$V_N$

$T_1$ $T_2$ $T_3$

FIGURE 2. BUS TIMING

| SIZE | CODE IDENT NO | DRAWING NO. |
|------|---------------|-------------|
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|-------|-------|---------------|

| 3 | 2 | 1 | 0 |
|---|---|---|---|

| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|----|----|----|----|----|----|---|---|---|---|---|---|---|---|---|---|

| 1 1 1 1 | SC | AG TG | ☒ | JAM ID | UP DW | TRK FILE ID | | |
|---------|-----|-------|---|--------|-------|-------------|---|---|
| 0 0 0 0 | FREQ | | | | | | CW | MF |
| 0 0 0 1 | DATA | | | AZ | | | V | T |
| 0 0 1 0 | AMP | L1 | L2 | ML | TOA (MSB) | PW | | |
| 0 0 1 1 | TOA (LSB) | | | | | | | |
| 0 1 0 0 | TRK FREQ | | | | | | ☒ | |
| 0 1 0 1 | ☒☒☒☒☒ | PRI PT | ☒☒ | TRK AZ | | | ☒ | |

| FIELD | FUNCTION | BITS(S) | SIGNIFICANCE |
|-------|----------|---------|--------------|
| TRK. FILE ID | TRACK FILE NUMBER | 0 – 6 | — |
| UPDW | UNASSOCIATED PDW | 7 | $1$ = UNASSOC. PDW |
| JAM ID | ET CHANNEL NUMBER | 8 – 12 | TO TECH. GEN. & EMITTER TRACKER |
| AGTG | TECHNIQUE GEN. FLAG | 14 | $AGTG \cdot \overline{UPDW}$ = TG OR ET DEST. |
| SC | SYSTEM CONTROLLER FLAG | 15 | $SC \lor UPDW$ = SC DESTIN. |
| | (CONTINUED) | | |

FIGURE 3. AUXILIARY BUS FORMAT

| SIZE | CODE IDENT NO | DRAWING NO. | |
|------|---------------|-------------|---|
| A | 49956 | 53959-JK-1003 | |
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| FIELD | FUNCTION | BIT(S) | SIGNIFICANCE |
|---|---|---|---|
| MF | MULTIFREQUENCY INDIC. | 0 | 1 = MULTIFREQ |
| CW | CW INDICATOR | 1 | 1 = CW |
| FREQ. | MEASURED FREQUENCY | 2-15 | LSB = 1.25 MHZ |
| T | TEST PDW IND | 0 | 1 = TEST PDW |
| V | VALID | 1 | ALWAYS = 1 |
| AZ | MEASURED AOA | 2-7 | LSB = 1 ANGLE CELL (SEE TABLE I) |
| DATA | SYSTEM CONTROLLER DATA | 8-15 | (SEE TABLE II) |
| PW | MEASURED PULSE WIDTH | 0-3 | |
| TOA(MSB) | MS 4 BITS OF TOA | 4-7 | LSB = 65,536 MICROSEC. |
| ML | MISSLE LAUNCH (ALR-50) | 8 | 1 = MISSLE LAUNCH |
| L2 | END OF LINKED PDW'S | 9 | 1 = END |
| L1 | LINKED PDW INDICATOR | 10 | 1 = LINKED |
| AMP | MEASURED AMPLITUDE | 11-15 | LSB = 1.6 DBM |
| TOA(LSB) | LS 16 BITS OF TOA | 0-15 | LSB = 1.0 MICROSECOND |
| TRK FREQ | SMOOTHED FREQUENCY | 2-15 | LSB = 1.25 MHZ |
| TRK AZ | SMOOTHED AZIMUTH | 2-7 | LSB = 1 ANGLE CELL |
| PRI PT | PRI POINTER | 10 | 1 = TBD, 0 = TBD |

FIGURE 3 (CONTINUED). AUXILIARY BUS FORMAT

| SIZE | CODE IDENT NO | DRAWING NO. | |
|---|---|---|---|
| A | 49956 | 53959-JK-1003 | |
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## TABLE I. DATA FIELD ENCODING

### BITS

| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
|----|----|----|----|----|----|---|---|

| | | | | | |
|---|---|---|---|---|---|
| | ACN | | | | 0 0 |
| IB | S1 | S2 | S BAND | | 0 1 |
| | PHASE COUNT | | | | 1 0 |
| | INVALID | | | | 1 1 |

VF *

| FIELD | FUNCTION | BITS(S) | SIGNIFICANCE |
|-------|----------|---------|--------------|
| ACN | ANGLE CELL NUMBER | 10-15 | LSB = 1 ANGLE CELL |
| S BAND | SIMULT. BAND (VALID IF MF=1) | 10-12 | LSB = 1 IFMR BAND |
| S2 | SPARE | 13 | |
| S1 | SPARE | 14 | |
| IB | INTRA-BAND SIMUL. PULSES | 15 | IB = 1, SIMUL. PULSES IN SAME BAND |
| PHASE COUNT | PHASE REVERSAL COUNT | 10-15 | LSB = 1 REVERSAL |

---

* THE VARIABLE FIELD (VF) CODE WILL BE 00 WHENEVER MF=0 AND THE IFM RECEIVER DOES NOT DETECT A PHASE-CODED RADAR.

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|------|---------------|-------------|---|
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TABLE II. PULSE WIDTH ENCODING

| PULSE WIDTH (NS) | BITS 0 | 1 | 2 | 3 |
|---|---|---|---|---|
| 0 - 200 | 0 | 0 | 0 | 0 |
| 200 - 300 | 0 | 0 | 0 | 1 |
| 300 - 350 | 0 | 0 | 1 | 0 |
| 350 - 400 | 0 | 0 | 1 | 1 |
| 400 - 450 | 0 | 1 | 0 | 0 |
| 450 - 500 | 0 | 1 | 0 | 1 |
| 500 - 550 | 0 | 1 | 1 | 0 |
| 550 - 600 | 0 | 1 | 1 | 1 |
| 600 - 700 | 1 | 0 | 0 | 0 |
| 700 - 800 | 1 | 0 | 0 | 1 |
| 800 - 900 | 1 | 0 | 1 | 0 |
| 900 - 1000 | 1 | 0 | 1 | 1 |
| 1000 - 1100 | 1 | 1 | 0 | 0 |
| 1100 - 3600 | 1 | 1 | 0 | 1 |
| > 3600 | 1 | 1 | 1 | 0 |
| INDETERMINATE | 1 | 1 | 1 | 1 |

| SIZE | CODE IDENT NO | DRAWING NO. | | |
|---|---|---|---|---|
| A | 49956 | 53959-JK-1003 | | |
| SCALE | | REV 2 | SHEET 10 of 14 | |
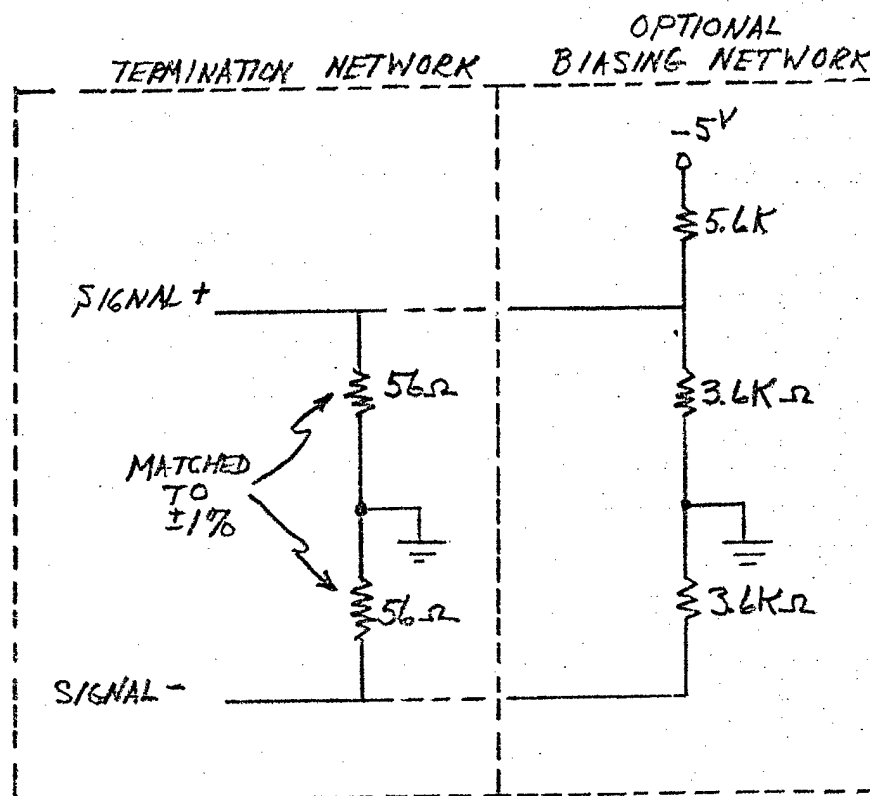
FIGURE 4. AUXILIARY BUS TERMINATION
AND BIASING NETWORKS

| SIZE | CODE IDENT NO | DRAWING NO. | |
|------|---------------|-------------|---|
| A | 49956 | 53959-JK-1003 | |
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LEXINGTON, MASS. 02173

CODE IDENT NO.
49956

SPEC NO.
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3.4.2      Interconnecting Transmission Lines

All interconnection cables used for this interface shall utilize twisted pair transmission line designs.   The nominal impedance shall be 110 ohms ±5%.

3.4.3      Interface Signal Definition

Figure 5 gives the auxiliary bus interface signals.   Signals AUD00 + and AUD00 – are the signal and return respectively for the least significant data bit.   AUD 15 is the most significant bit.   AUI00 through AUI03 are the Identification Bits (AUI00-03 = 0000 implies message word zero).   AULD is the load strobe.   AUENL is the Enable Signal to the STE generated by the Sorter.   $\overline{AUACT}$ originates in the STE when it assumes bus control.  Pin connections for J7 and J8 shall be identical.

AUXILIARY BUS

| PIN #'s | | PIN #'s | J7 & J8 IN SIGNAL SORTER |
|---|---|---|---|
| 1 | AUD00+ | 1 | LSB |
| 2 | AUD00- | 2 | |
| 3 | AUD01+ | 3 | |
| 9 | AUD01- | 9 | |
| 4 | AUD02+ | 4 | |
| 10 | AUD02- | 10 | |
| 5 | AUD03+ | 5 | |
| 11 | AUD03- | 11 | |
| 6 | AUD04+ | 6 | |
| 12 | AUD04- | 12 | |
| 7 | AUD05+ | 7 | |
| 13 | AUD05- | 13 | |
| 8 | AUD06+ | 8 | |
| 14 | AUD06- | 14 | |
| 15 | AUD07+ | 15 | |
| 16 | AUD07- | 16 | |
| 17 | AUD08+ | 17 | |
| 18 | AUD08- | 18 | DATA |
| 19 | AUD09+ | 19 | |
| 20 | AUD09- | 20 | |
| 21 | AUD10+ | 21 | |
| 22 | AUD10- | 22 | |
| 23 | AUD11+ | 23 | |
| 24 | AUD11- | 24 | |
| 25 | AUD12+ | 25 | |
| 34 | AUD12- | 34 | |
| 27 | AUD13+ | 27 | |
| 36 | AUD13- | 36 | |
| 28 | AUD14+ | 28 | |
| 37 | AUD14- | 37 | |
| 29 | AUD15+ | 29 | |
| 38 | AUD15- | 38 | MSB |
| 30 | AUI00+ | 30 | LSB |
| 39 | AUI00- | 39 | |
| 31 | AUI01+ | 31 | |
| 40 | AUI01- | 40 | |
| 32 | AUI02+ | 32 | IDENT |
| 41 | AUI02- | 41 | |
| 33 | AUI03+ | 33 | |
| 42 | AUI03- | 42 | MSB |

(CONTINUED ON NEXT PAGE)

FIGURE 5.    INTERFACE SIGNAL LIST

| SIZE | CODE IDENT NO | DRAWING NO. |
|---|---|---|
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AUXILIARY BUS    PIN #'s        PIN #'s    J7 & J8 IN SIGNAL SORTER

| | PIN #'s | | PIN #'s | |
|---|---|---|---|---|
| | 26 | SPARE | 26 | |
| | 35 | SPARE | 35 | |
| | 47 | SPARE | 47 | |
| | 48 | SPARE | 48 | |
| | 49 | SPARE | 49 | |
| | 50 | SPARE | 50 | |
| ← | 45 | AULD+ | 45 | |
| ← | 46 | AULD− | 46 | |
| ← | 51 | ATENL+ | 51 | |
| ← | 58 | ATENL− | 58 | |
| | 43 | $\overline{AUACT}$+ | 43 | → |
| | 44 | $\overline{AUACT}$− | 44 | → |
| | 52 | SPARE | 52 | |
| | 59 | SPARE | 59 | |
| | 54 | SPARE | 54 | |
| | 61 | SPARE | 61 | |
| | 55 | SPARE | 55 | |
| | 62 | SPARE | 62 | |
| | 56 | SPARE | 56 | |
| | 57 | SPARE | 57 | |
| | 63 | SPARE | 63 | |
| | 66 | SPARE | 66 | |
| | 64 | SPARE | 64 | |
| | 65 | SPARE | 65 | |
| | (NO CONNECTION) | AU5VR (USED IN SORTER ONLY) | 53 | |
| | (NO CONNECTION) | AU5VR (USED IN SORTER ONLY) | 60 | |

} Pass-Ons Only
(Not Used Internal to Sorter)

FIGURE 5. (CONT.)  INTERFACE SIGNAL LIST

| SIZE | CODE IDENT NO | DRAWING NO. |
|---|---|---|
| A | 49956 | 53959-JK-1003 |
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